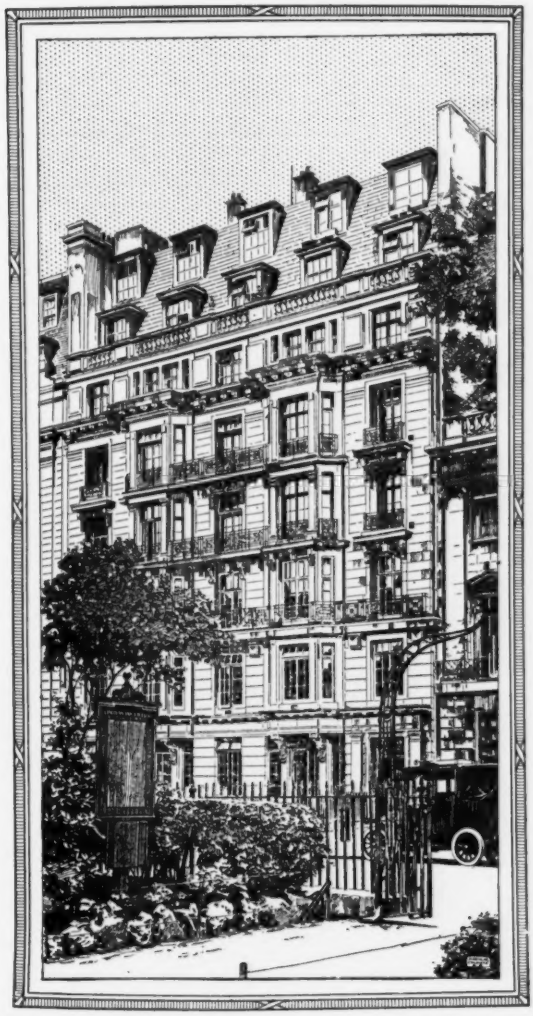
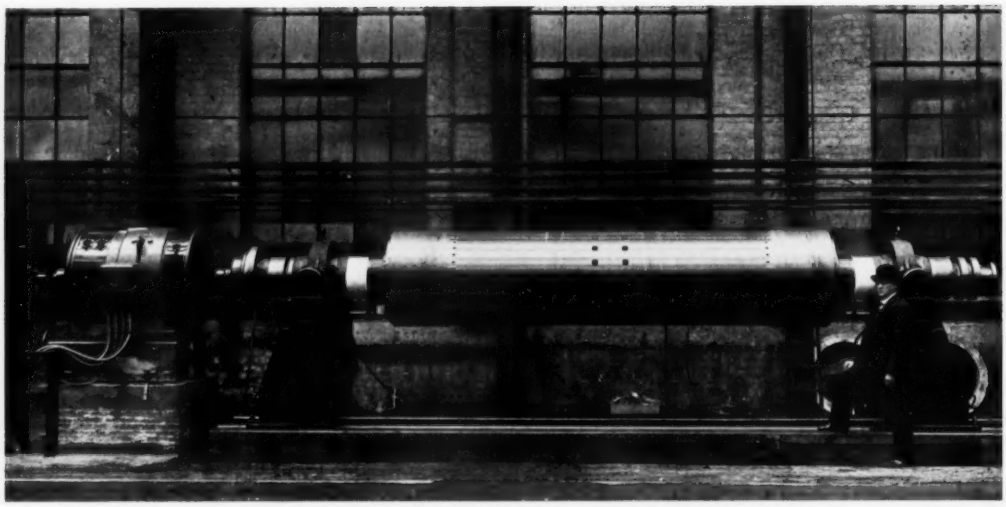
The ENGLISH ELECTRIC JOURNAL

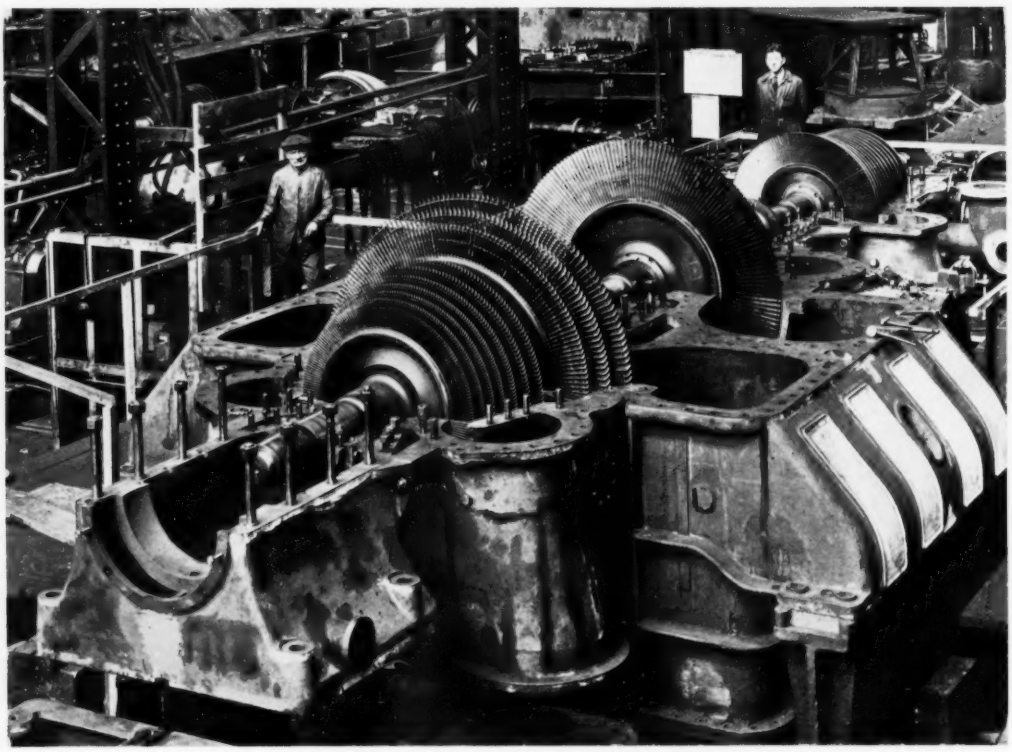


Queen's House from Lincoln's Inn Fields.

All rights of republication including translation of articles, are reserved.



25,000 kW. & 30,000 kW. at 3,000 R.P.M.



THE ALTERNATOR ROTOR IS FOR A 25,000 KW. MULTI-CYLINDER TURBO-ALTERNATOR SET FOR LEICESTER. THE TURBINE SHOWN UNDER ERECTION IS FOR A 30,000 KW. SET FOR WEST HAM.

The English Electric Journal

Vol. IV. No. 7 MAY, 1929 One Shilling.

CONTENTS.

PAGE

AUTOMATIC SUBSTATIONS OF THE KEIHAN ELECTRIC RAILWAY, JAPAN - - - - - 174

SOME NOTES ON TRACTION CONTRACTS - - - - - 181

"ENGLISH ELECTRIC" POWER FACTOR COMPENSATOR - - 186

LOW-VOLTAGE AUXILIARY SUPPLY ON D.C. ROLLING STOCK - 189

All Communications respecting Editorial Contents should be addressed to THE EDITOR, THE ENGLISH ELECTRIC JOURNAL, QUEEN'S HOUSE, KINGSWAY, LONDON, W.C.2.

1919—1929—AND THE FUTURE.

During its first ten years the English Electric Company experienced the hopes and disappointments, the successes and failures that marked for so many concerns the passage from the artificial conditions of the War years to a position of stability when subjected to world-wide competition. The many difficulties that arose have been surmounted by the determination and co-operation of all ranks in the Company's service, and this all-British concern now enters upon its second decade with a full confidence in its future, based upon the proved skill of its personnel and quality of its products.

In 1928 orders were no easier to secure than in 1927. Moreover, the prices ruling were lower by from 15% to 50% according to the class of goods. Nevertheless, after making every provision dictated by a cautious and conservative policy, the Company achieved a very substantial improvement in its Balance Sheet. The significance of this improvement as an indication of the increased

efficiency of the organisation cannot be doubted, and the Company has never been in a better position than it is to-day to undertake the complete range of electric power and electric traction contracts that its operations cover.

Nearly ten years ago we gave in these columns a brief account of the formation of the English Electric Company by the amalgamation of the interests of the Dick, Kerr, Willans & Robinson and Phœnix Dynamo Companies and the subsequent purchase of the Stafford works of Siemens Brothers Dynamo Works, and it may be of interest to our friends, old and new, if we now broadly survey its various activities. Also, it may not be out of place here to refer to the great traditions of British Engineering which the Company inherited, and which, we hope, it may claim to have carried forward in a worthy manner. At the Preston, Rugby, Bradford and Stafford Works of these old Companies, who were all pioneers in electric power and traction work, the English Electric Company still manufactures the corresponding modern products, bearing, as before, the hall-mark of "A1 British" manufacture.

A visitor to the English Electric Works at Rugby can have the unique experience of inspecting under one roof the manufacture of the largest and most modern types of prime mover for operation by Steam, by Oil, and by Water Power, and those to whom the Willans central-valve engine was a synonym for ingenuity and precision will find a modern rendering in the Fullagar engine, which, as developed by this Company, has proved an unqualified success. The Company's high-speed multi-cylinder steam turbines and their work on turbines for extra high steam pressures are widely known, as is also the remarkable position attained in a few years in the manufacture of water turbines. At Rugby there will also be found the Comprehensive Contract Department, whose capacity for handling schemes of great magnitude is shown by such completed and current contracts as Athens, Budapest, Belquas, Kemsley, Khartoum, Preston, Blackburn, Leicester and Peterborough.

Preston, the cradle of electric traction in this country, is just as vital a factor to-day in advancing development and practice as it was 28 years ago. It has recently taken a prominent place in the development of Diesel-electric and trolley-bus traction, and its research department and test track are daily engaged in improving the performance and economy of the various classes of traction equipment. Preston will deliver a complete railway or tramway system, a fleet of complete trolley buses, or alternatively, the electric equipment for any of these, or bodies of the most modern-comfort type for any make of petrol bus. A further development at Preston is the range of high-voltage generators for broadcasting stations, in which special "English Electric" features are incorporated. These machines produce direct-current power at pressures of 15,000 to

20,000 volts in a single unit. The manufacture of water turbines is also carried out at Preston as well as at the Rugby Works.

The Bradford Works is the largest in the country devoted entirely to the manufacture of electric motors and their control gear, and although it is essentially a mass production factory, it produces various classes of alternating current machines to meet the modern demands for improved power factor, smooth starting, speed variation, etc. It is to be noted that the Bradford factory led the way in this country in the use of ball and roller bearings, and in the scientific ventilation of motors for industrial purposes.

Last but not least, in the Works at Stafford are to be found all the large machines and the varied and intricate apparatus which links the prime movers to the individual motors, etc., at the end of the system. The visitor will there find the largest and most modern types of generating and converting plant of every description, main and auxiliary switching installations, automatic control apparatus, and transformers suitable for the highest voltages and of the largest sizes. But, we believe that the Stafford Works are so well known to engineers in all parts of the world that it is not necessary for us to refer further to them here, except to remark that during the last ten years large additions have been made to the shops, in order to deal with a greatly increased turn-over.

The co-ordination of the several Works, the drawing together of the manufacturing and commercial sides of the various departments, the improved allocation of the various products, in short the true rationalisation of the English Electric Company's organisation, has been a matter of special study during the last few years. As a result the Company has greatly strengthened its position for more efficient and economic manufacture, and we believe that it can confidently claim to give its friends, in an even greater degree than before, that service and high quality which have always been the distinctive mark of a first-class British Engineering Firm.

Our Frontispiece.—The two illustrations which have been chosen for the frontispiece of this number represent two of the many large Power Station units now under construction for installation at home and in a number of countries overseas. The alternator rotor which is seen mounted in the balancing machine is for a 25,000 kW. set for Leicester which will have a 3,000 r.p.m. turbine of the Company's well-known two-cylinder design; a unit of the same output for Sheffield will, owing to the high steam pressure, have a three-cylinder turbine.

The lower illustration shows a 30,000 kW. turbine for West Ham in course of erection at the Works, and it will be noted that the low-pressure end consists of two cylinders; another turbine of this size is being manufactured for Bradford.

Automatic Substations of the Keihan Electric Railway, Japan.

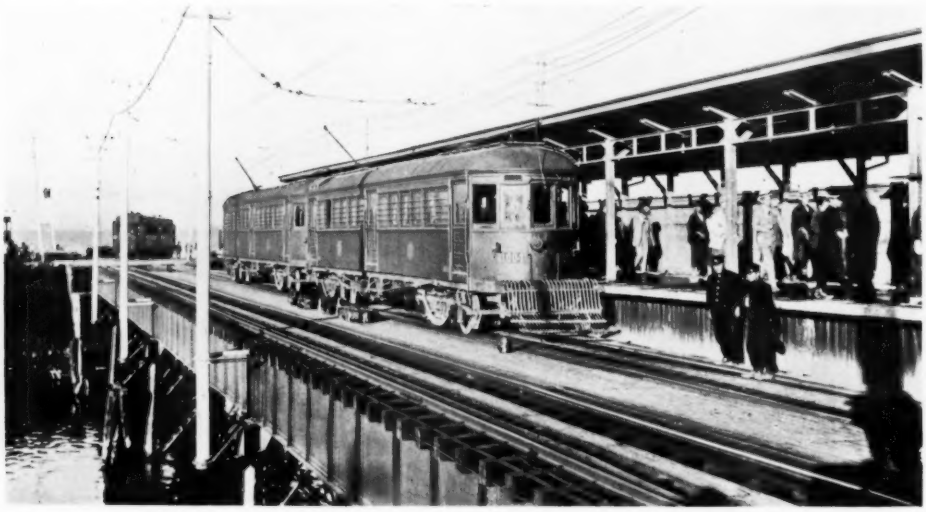


FIG. 1. MOTOR-COACH TRAIN AT A TERMINAL STATION OF THE KEIHAN RAILWAY.

By the courtesy of the Management and engineering staff of the Keihan Denki Tetsudo K.K. we are able to give in this number a description of the general layout of the system, and some detailed particulars of the sub-station plant on the older of the two electric railways which connect Osaka, the largest industrial city of Japan, with Kyoto, the old capital. It may be explained that this busy district was served at one time only by the steam line of the Imperial Government Railways, but in 1910 the Keihan Company commenced their electric service, which in course of time became one of the busiest lines in the country. As certain limitations imposed by the construction of the line and system of operation prevented any further increase in the amount of traffic carried, a project was launched for the construction of a new electric railway, the Shin Keihan Railway, and this was duly constructed and opened for a through service in November of last year. It is hoped in a subsequent number of this journal to supplement the present description by giving similar particulars of the newer railway.

The steam trains of the I.G.R. cover the distance of about thirty miles between the two cities in approximately 45 minutes, but they run at infrequent intervals. The electric trains of the Keihan Company give a very frequent service at intervals of three minutes, with express trains every 10 minutes which complete the journey in about 70 minutes.

When the Keihan Company commenced its operations in 1910 it had its own Power House containing three Willans Dick-Kerr Turbo-alternator sets of 1,000 kW. each, giving a three-phase supply at 25-cycles. This supply was stepped up to 22,000 volts, and transmitted to three sub-stations at Moriguchi, Fushimi and Hirakata. Each of these stations contained three 500 kW. Dick-Kerr Rotary Convertors. At a later date, due to standardisation of frequency, and the erection of large hydro-electric power stations in the district, the Company decided to shut down their own power plant and to purchase electrical energy from the Daido Company.

The supply from Daido is received at 55,000 volts, 60 cycles, and is stepped down at Moriguchi

No. 2 station, Fushimi No. 2 station, and Takatsuki No. 2 station to 22,000 volts, and distributed at this pressure by duplicate feeders to the various sub-stations. In addition to supplying power for their railway the Keihan Company also give a service for industrial and lighting purposes.

Fig. 2 is a rough map of the district, and Fig. 11 shows diagrammatically the relative position of the seven sub-stations between Osaka and Kyoto. Power is delivered to the rolling stock from an overhead trolley wire at 600 volts and the negative of the system is earthed. The whole of the equipment for the sub-stations was supplied by The English Electric Company ; it comprises thirteen 1,000 kW. rotary convertors, with complete automatic or manual control apparatus. The method of control used in the various sub-stations was decided upon by the Keihan Company's engineers, after very careful study of the service conditions to be met, and in close co-operation with the engineers of The English Electric Company. The central feature of the automatic switching equipments is the camshaft controller of the type which The English Electric Company has installed so widely, both for this class of work and also for the control of electric rolling stock.

The sub-stations at Gamo, Neyagawa and Tofukuji are identical both as regards the layout of the buildings, the equipment and the method of control. Fig. 3 is a general view of the Neyagawa sub-station, showing the outdoor 22,000-volt lightning arrester gear seen in the foreground, and the storage battery room on the left-hand side. The equipment of each of these sub-stations is as follows :—

2—1,000 kW. Rotary Convertors, 600-volt level compound wound, with exciter and running at 900 r.p.m.

These machines are tap-started from their associated transformers, are fitted with roller bearings, and have overload ratings of—

50% for 2 hours.
100% for 1 minute.
200% momentarily.

2—1,100-kVA. 22,000-volt, 60-cycle Rotary Convertor Transformers, with tappings for 21,000 and 20,000-v. and also L.T. tappings for starting.

2—22,000-volt, 3-phase, 60-cycle incoming and transformer switchgear equipments, with oil breakers operated by D.C. solenoid gear.

2—Starting and Control Relay Panels incorporating the camshaft controllers, which contribute in no small degree to the simplicity and successful operation of these sub-stations.

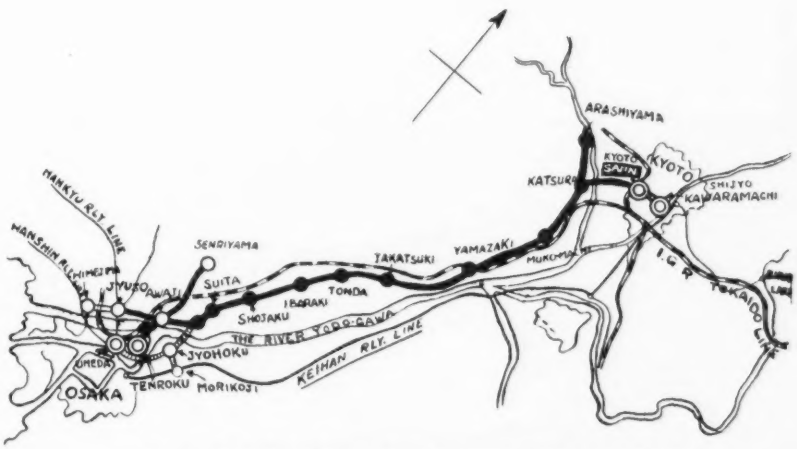


Fig. 2. Sketch Map of Railways between Osaka and Kyoto.

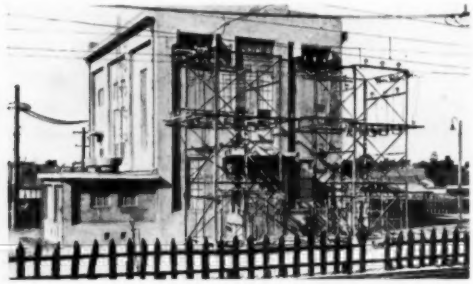


FIG. 3. NEYAGAWA SUBSTATION.

1—Master Control Relay Panel, carrying the time switches, sequence switches, etc.

1—Four-panel, 600-volt D.C. Switchboard carrying two Rotary Convertor Control Equipments with 2,400-ampere contactors for the positive connection. Two Feeder panels, each provided with a 2,000-ampere high-speed circuit-breaker, with short-rated limiting resistance and auxiliary contactor, and one additional feeder panel now being installed.

Fig. 4 shows one of the machines in the Neyagawa station with the master control panel and the two A.C. control panels on the right. In Fig. 5, the D.C. control panel is shewn, and above it, on the gallery, the 2,400 ampere contactors. On the right are the 2,000-ampere high-speed breakers and auxiliary contactors. Fig. 6 shows the D.C. control switchgear in Gamo substation.

Each of these sub-stations is arranged so that it can be operated alternatively by time switch control or remote control. In the case of the former, starting up is under the control of two time switches, a master time switch and an emergency time switch. Normally the first-named provides the starting impulse for the station and causes the first machine to start up. The second machine is brought into service by prolonged or heavy overload on the first machine. The emergency time switch can be used if desired, to anticipate or corroborate the action of the overload devices which normally bring the second machine into service.

The first machine to shut down is usually the one which started up second, and shutting down is normally brought about by under-load conditions on this machine. The operation of the under-load relay can, however, be anticipated or confirmed by the emergency time switch. The machine which started up first and normally shuts down last is taken out of service through the operation of the master time switch.

For the alternative method of operation of these automatic sub-stations by remote control, remote control panels are erected in the manual sub-stations. Each of these carries a switch for starting, a switch for stopping, and a red indicating lamp to show that the automatic sub-station is in operation. To start an automatic sub-station the starting switch is closed and kept in that position until the red indicating lamp lights, thereby showing that the machine is on load. The second machine is brought into operation by overload conditions on the first one, in exactly the same way as for time switch control, the operation of the overload devices being supplemented by the emergency time switch, if necessary. With this method of control shutting down of the second machine will occur on under-load, and the other machine will be shut down by the operator from the remote control panel by means of the " stop " push-button switch. When the sub-station is out of commission the operator receives an indication by the extinction of the indicating lamp. When both machines are in operation they can be stopped simultaneously by the use of this " stop " switch.

FIG. 4. INTERIOR OF NEYAGAWA SUBSTATION.

Some of the special features of the equipment to which attention may be drawn are the inspection switch, which is located on the time switch control panel, and enables either machine to be started up at any time for inspection; a push-button switch on each controller cubicle to provide for instantaneous shutting down; and sequence switches on the master control relay panel for setting the order in which the machines are to come into operation. With regard to the latter it may be said that if the sequence switches are set for No. 1 machine to start up first, and for No. 2 to come in under overload conditions, any derangement of No. 1 set, which is sufficient to prevent it commencing operation, will lead to No. 2 set coming automatically into service. One other feature is the starting impulse switch on the master control relay panel, which determines, according to whether it is in the up or down position, the method of control, either by time switch or from the remote manual station.

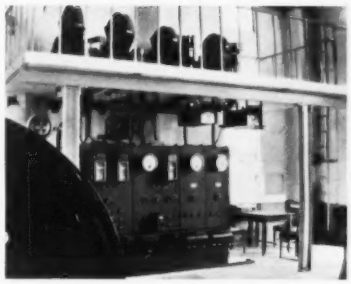


FIG. 5. NEYAGAWA; D.C. CONTROL PANELS.

A good insight into the principles on which the automatic apparatus works may be gained by considering the normal operation of one of the sub-stations, say Tofukuji, where the master time switch is set for 5 a.m. Assuming the E.H.T. feeder is alive, and the sequence switch set for No. 1 machine to start first, the control circuit for this machine is already complete, and, therefore, immediately the time switch makes contact, the oil circuit-breaker closing relay on No. 1 equipment is energised and operates after a time interval. No. 1 oil breaker closes and the rotary convertor starts to run up on the low-voltage tap connection with its field across the discharge resistance. The direct-coupled exciter begins to generate, and when it has reached 80 per cent. of its full voltage, the field-making relay is energised and operates after an interval of about 25 seconds. This relay connects the field of the rotary convertor across the exciter with a limiting resistance in series and with the discharge resistance in parallel. The rotary convertor is thereby pulled into synchronism on a weak field.

The synchronising relay now comes into action. It has two coils, one energised from the rotary convertor and the other from a battery, with the result that until the rotary convertor pulls into synchronism there is an oscillating current through the machine coil and the plunger is not drawn up.

As synchronism is approached, the oscillations die down until, on finally pulling into step, the machine coil exerts a steady pull on the plunger. If the polarity is correct, the combined effect of the two coils causes the relay to operate, which completes a circuit from the exciter to the camshaft motor relay. The rotation of the camshaft completes the remaining connections in the correct sequence, after which the controller is brought to rest through the opening of two of its contacts, which interrupts the circuit to the camshaft motor relay so that the controller stops. The low-voltage relay which is brought into operation by the camshaft controller causes a circuit to be completed to a reclose relay, which, in turn causes the main D.C. breaker to close. The 600-volt busbars are thus made alive, and consequently the operating coils of the feeder reclose relays are energised so that the auxiliary contacts close and the feeders are connected through limiting resistances to the line. Provided the line is "safe" the feeder high-speed breakers then close and short-circuit the limiting resistance and auxiliary contactor.

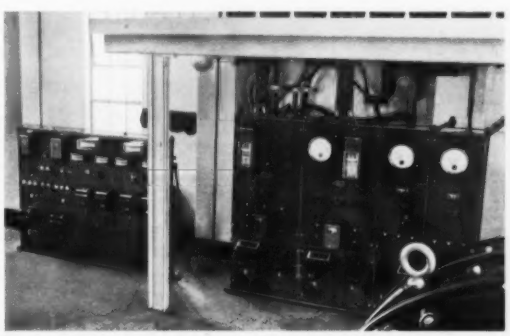


FIG. 6. GAMO; D.C. CONTROL SWITCHGEAR.

The first machine is now on load, and the second unit is available when required by reason of overload or any fault on the first machine. At midnight the master time switch operates and shuts the first machine down. This causes the No. 1 or master circuit to be interrupted, so that the no-volt relays are de-energised, tripping the oil-breaker and the D.C. positive breaker. If only one machine was running, as has been assumed, the busbars are rendered dead, and therefore, the pull-on coils of the D.C. feeder breakers are de-energised and the breakers open. When the oil breaker opens, an auxiliary contact makes circuit to the camshaft motor through its relay, and the camshaft controller commences to rotate to its starting position. In doing this it performs the following operations :—

The field of the rotary convertor is connected across the discharge resistance and disconnected from the exciter ; the slipring connections to the full A.C. voltage are opened and they are connected to the lower voltage tapping. The controller is then brought to rest by the opening of two of its contacts. The unit is now ready for another start as soon as it is required.

The parallel operation of the rotary convertors is perfectly satisfactory, as equal distribution of the load is ensured as between the hot and the cold machine by The English Electric Company's patented method of placing the exciters and the field circuits of the two machines in series. Equalising switches are mounted on the camshaft controller and make circuit at the same time as the low-tension A.C. main running contacts are made. If, when both machines are carrying the load a fault should develop on one of them, causing it to shut down, provision is made that the other machine will not be shut down by the emergency time switch, but only by the master time switch.

On the occurrence of a heavy over-load or short-circuit on any feeder, the high-speed breaker (device No. 50) will open and insert the load limiting resistance, as shown in Fig. 7. The current in the limiting resistance causes device No. 52 to be energised and the circuit to the hold-on coil of the auxiliary contactor (Device No. 51) to be broken, so that the contactor opens

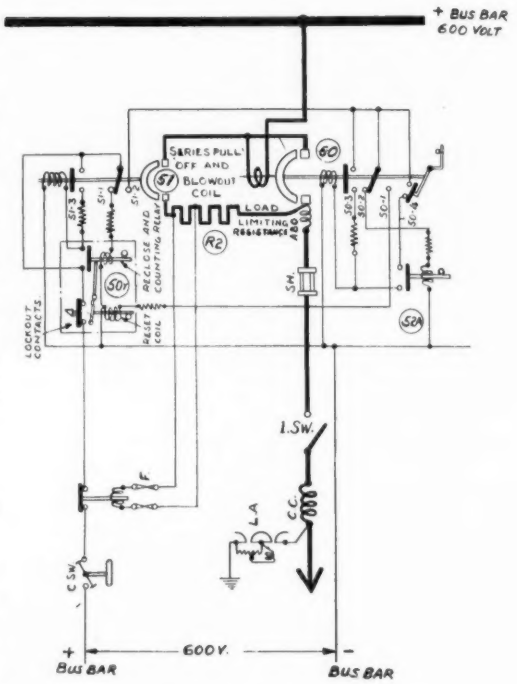


FIG. 7. DIAGRAM OF D.C. CONTROL GEAR.

and completely isolates the affected feeder. As there is then no current through the limiting resistance, device No. 52 is de-energised and its contacts close again, completing a circuit from the positive busbar to the operating coil of the auto-reclose mechanism (Device 50Y). The latter operates after a time interval of 25 seconds, and again closes the auxiliary contactor. If the feeder conditions are now normal, the high-speed breaker is closed after an interval of one second, but if the fault persists the auxiliary contactor will continue to open until three unsuccessful attempts have been made, when the lock-out contacts of relay 50Y, the auto-reclose mechanism, operate and the auxiliary contactor is locked out and the faulty feeder isolated. In addition to a full scheme of protective devices which are provided as standard on all " English Electric " Automatic Switching Equipments, there are also a number of standard indicating arrangements to assist an inspector readily to locate a fault. These consist of in-

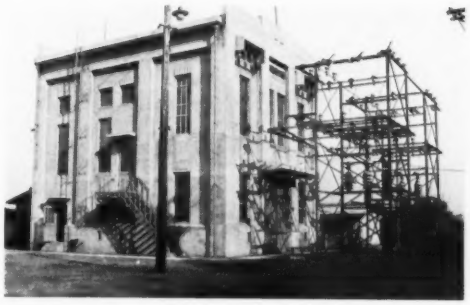


FIG. 8. HASHIMOTO SUBSTATION.

dicating lamps, mounted on each camshaft control cubicle, to indicate when any of the following protective devices have operated :—

Bearing thermostats.

Machine thermostats.

Overspeed device.

A.C. Overload and leakage relays.

Incomplete starting device and total time relay.

There are also indicating flags which can be seen through the glass windows at the top of the relay cases and give indications for the lock-out relays of the D.C. feeder breakers and the rotary positive breaker.

The fourth of the fully automatic sub-stations is that at Hashimoto, where the equipment is exactly the same as at the three sub-stations so far described, with the exception that the rotary convertors are shunt-wound, the oil-breakers are operated by A.C. motors, and there are four D.C. feeders. A general view of this station is shown in Fig. 8, while Figs. 9 and 10 show the interior, with the D.C. control panels and the feeder high-speed breakers.

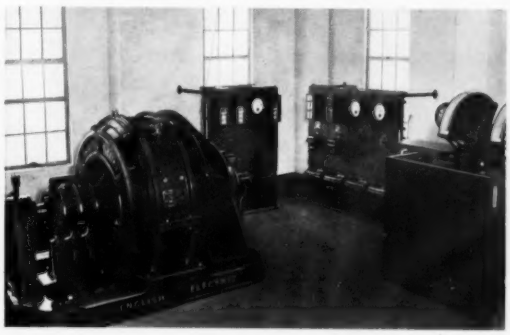


FIG. 9. HASHIMOTO; D.C. CONTROL PANELS.

The method of control is generally similar to that in the other sub-stations, with the exception that in this case remote control was not considered advisable in view of the distance to the nearest sub-station on either side being more than five miles. The station is started and stopped by time switch, or alternatively, the first machine may be started up by drop in trolley volts and shut down on under-load. The operation of the second machine is exactly the same as for the other sub-stations.

It is of interest to record an experience which has occurred in operating these plants. It has been found that due to the falling voltage characteristic the Hashimoto sub-station backs off from the peak loads and the manual sub-stations on either side at Fushimi and Hirakata are more evenly loaded. On the other hand Tofukuji sub-station, being level compound-wound, does not do this, and the second rotary often has to come into service for short periods to take care of these peak loads. This station is, therefore, now being altered to shunt-wound, and it is anticipated that the peak loads will then pass on to the manual Fushimi sub-station, which, by reason of its larger capacity, is able to deal with them without the necessity of starting up another unit. Due to the location of the Gamo and Neyagawa sub-stations at the Osaka end, and also to the traffic

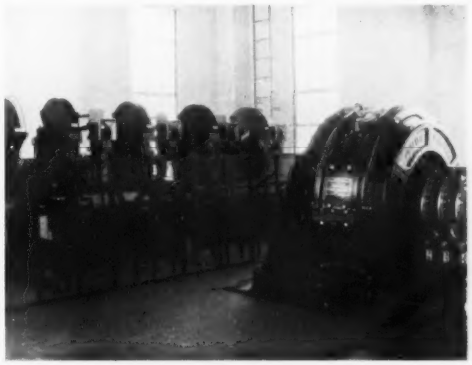


FIG. 10. HASHIMOTO; HIGH-SPEED BREAKERS.

at the moment, it has not been considered desirable to alter these sub-stations to shunt winding, although it is the intention to do so at a favourable opportunity.

The traffic schedule of the line is very consistent, and there is a steady basic load which hardly varies. Consequently, the system of starting and stopping the first machine in each sub-station at a definite time was chosen, and this has been thoroughly justified. Extra load, due to rush hours during the day, or on particular days due to festivals or holidays, is provided for by the second unit coming into operation by the overload device or emergency time switch ; for example, to consider again the Tofukuji sub-station, the normal daily routine is for the first machine to be started up by the master time switch at 5 a.m., and to shut down at midnight. The rush hours on this section of the line occur morning and evening, with the result that the second machine in this sub-station comes into operation at about 7 a.m. due to overload, and shuts down at 9.30 a.m. due to under-load. The same cycle occurs again at 4.30 p.m. and 9 p.m.

The whole of the plant in these sub-stations was erected and put into operation successfully by the Keihan Company's engineers, the Hashimoto sub-station having been inaugurated in September, 1927, and the other three sub-stations converted to automatic control in the middle of 1928.

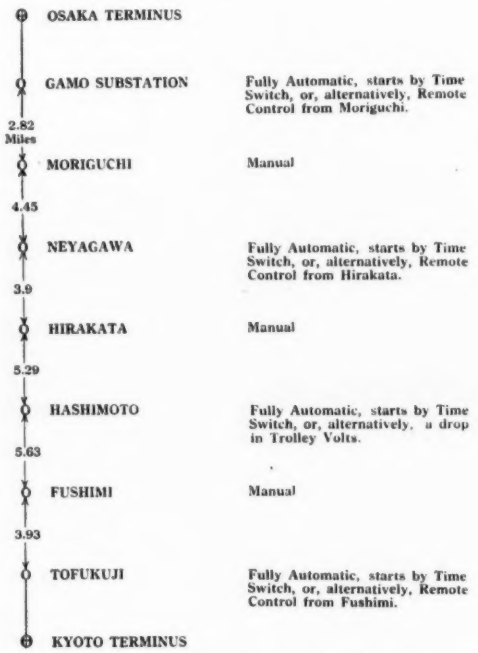


FIG. 11. POSITIONS OF THE SUBSTATIONS.

Fig. 1 is a view of a motor-coach train at one of the terminal stations on the Keihan line. Numerous orders have been executed by this Company from time to time for motors and control gear for the equipment of the rolling stock.

For a **New Granary** to be erected at Bahia Blanca by the Buenos Ayres Great Southern Railway, " English Electric " motors have been ordered for operating the comprehensive grain-handling equipment that is being supplied by Messrs. Henry Simon, Ltd. More than 180 motors totalling nearly 9,000 Horsepower, in sizes from 5 H.P. to 180 H.P., will be installed for driving the various elevators, lifts, fans, runways, haulages separators, etc. This is a further addition to the list of docks where the Company's motors have been installed on a large scale, which has included amongst others Avonmouth, Capetown, Southampton, Tynemouth and Montreal.

The long experience of the Company in tram-car construction and the ample facilities of their car shops are no doubt responsible for the considerable demand that has arisen for **Bus Bodies**, and for complete Electric **Trolley Buses** of their manufacture. Recent orders for the latter include six Double-deck, six-wheeled, buses for Bradford, and six single-deck, four-wheeled buses for Darlington. Complete buses or bus equipments to the number of forty have now been ordered by Bradford.

The Bodies supplied for petrol buses of many makes represent the best and latest practice in structural design and in comfort. A series of Six double-deck, six-wheeled vehicles now being delivered to Southampton is similar to a fleet recently completed for Portsmouth. ' Other recent contracts have been for Oldham, Blackpool and Ashton-under-Lyne.

Some Notes on Traction Contracts.

FIG. 1. 50-TON BATTERY LOCOMOTIVE IN CARNAC BRIDGE YARD, BOMBAY.

Shunting Locomotives in Operation in India.

The April 1928 issue of this Journal contained an illustrated description of two 50-ton four-axle battery locomotives supplied for operation at the Carnac Bridge Yard of the Bombay, Baroda and Central India Railway. In view of the fact that large battery locomotives had not hitherto been seriously considered for service in India, it is believed that a short account of the work being performed by these units, together with some illustrations of them under service conditions, will be of interest to our readers.

The locomotives were given complete tests on the track at Preston Works under the supervision of the consulting engineers, Messrs. Rendel, Palmer & Tritton, and were subsequently shipped to Bombay ready for running after the batteries had been filled with acid and charged. The Terminal Goods Yard at Carnac in which the locomotives are used is situated in the middle of the city of Bombay in a thickly populated area, and the Shunting Yard is bounded on one side by the General Hospital. Shunting with steam locomotives had to be carried on during the whole 24 hours, and the Railway Company received numerous complaints of the noises of the shunting, and escaping steam. Moreover, in order to allow for a 24-hours service, three steam locomotives were required to operate the three eight-hour shifts.

The electric locomotives have now been in full operation carrying out all the work at the Carnac Bridge Yard since November of last year, and have entirely displaced the steam units which previously dealt with the train marshalling and shunting movements. They now deal with all the shunting in two eight-hour shifts.

The new locomotives were first run for the purpose of training drivers; when put into shunting service the first arrangement made was that each locomotive should be used during a twelve-hour shift, the second one receiving its charge during that time, the drivers, shunters and yard staff being employed in three eight-hour shifts as before. After some weeks of this operation it was found that the increased speed of movement obtained enabled the time occupied in shunting to be cut down very considerably. The main factors which led to this were the rapid

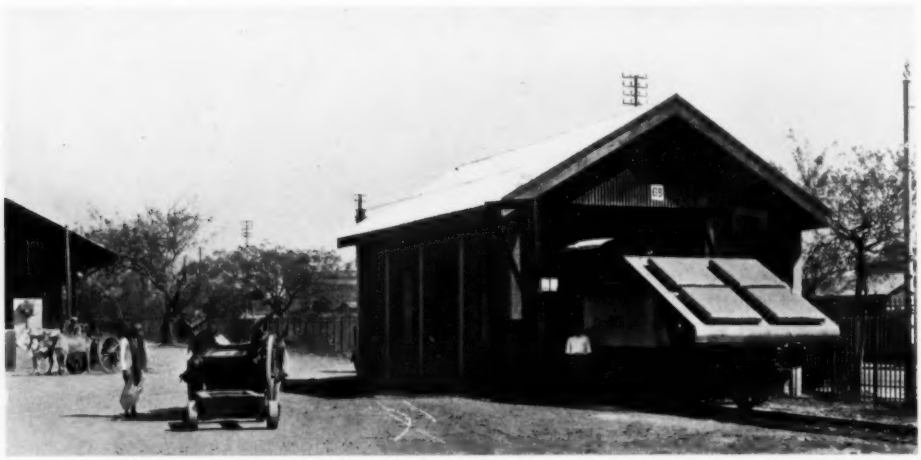


FIG. 2. A LOCOMOTIVE AT THE CHARGING SHED.

acceleration and deceleration of the electric locomotives, the rapid release of the electro-pneumatic brakes and the quickness with which the direction of travel could be reversed. The Railway Company naturally took full advantage of the possibility of speeding up the working, and they now find that the whole of the shunting can be handled comfortably in two eight-hour shifts. It can be readily appreciated that this opened up the prospect of considerable economies. Apart from the reduction in the stand-by losses inherent in working with steam locomotives, the cost of the yard staff has been greatly reduced. Further, it has been found that the battery locomotives are so simple to handle that it is not necessary to use trained steam drivers, and a number of firemen are being promoted to a grade of shunting drivers, thereby releasing steam drivers for service elsewhere. Added to these financial economies shunting now takes place in comparative silence.

The special provision which was made for ventilation by means of double-walled battery compartments with free circulation of air between the walls and through the compartments has been entirely successful in keeping the batteries at a temperature at which they give the high rates of discharge required. The efficiency of the cooling can be judged by the fact that whereas the locomotives were originally designed to haul trailing loads of 600 tons, it is found that a rake of 1,000 tons is handled five or six times a day.

There is little doubt that a wide scope exists for the employment of electric locomotives for similar purposes on other railway systems, and that their introduction will follow when the Companies are better acquainted with the good performance, ease of operation and low maintenance costs of such units. The results obtained in the present case are particularly gratifying in view of the exceptional climatic conditions.

The above particulars are published by kind permission of the Chief Electrical Engineer of the B.B. & C.I. Railway and of the Consulting Engineers.

General Service Locomotive for Montreal Harbour Commissioners.

The Montreal Harbour Commissioners ordered from The English Electric Company a general service locomotive for repair and construction work, which has just been delivered to Montreal. It will be recalled that previously, orders totalling nine 100-ton electric locomotives have been executed for the Montreal Harbour Commissioners, and that these locomotives have been in successful operation for several years. Fig. 3 is a general view of the new locomotive, and Fig. 4 is an interesting picture of five of the 100-ton units which were described in the Journal of December, 1926.

The locomotive now supplied had, of course, to be a self-propelled unit, since one of its important uses will be in connection with repairs to the overhead line. It is, therefore, of the Gasoline-electric type. In general design it is of the box cab type mounted on two equal wheel bogies, on one of which are mounted two standard traction motors.

The motive power is supplied by a 100-h.p., 6-cylinder Leyland engine, coupled to a 52-kW., 500-volt main generator and a 120-volt auxiliary generator. The motors are driven from the 500-volt generator, and the driving controller is arranged with 12 notches, by means of which very fine variation in speed can be obtained up to the maximum normal speed of 12 m.p.h. in either direction, when hauling a load up to 50 tons.

The engine runs at a speed of 1,200 r.p.m., and is fitted with an automatic control device which maintains this speed to within plus or minus 2 per cent. between no load and full load. The radiator is fan cooled and mounted inside the locomotive cab ; cooling air is drawn from underneath the locomotive, and the hot air is expelled through the roof. There is a driving compartment at each end and a central compartment housing the engine and generators, and the auxiliary machinery.

Among the numerous services to be performed by the locomotive is that of supplying compressed air for working pneumatic tools. For this purpose there is installed a 2-VCA-21 Westinghouse air compressor rated at 150 cub. ft. of air per minute at a pressure of 100 lbs. per sq. in., and this is driven by an electric motor operated from the 500-volt generator. As this generator also supplies the current to the traction motors, suitable interlocks are provided to ensure that the generator is switched either on to the traction motors or on to the compressor motor, so that while pneumatic tools are in operation the locomotive cannot be moved from its position. A large bank of reservoirs totalling 60 cub. ft.

FIG. 3. 54-TON GENERAL SERVICE LOCOMOTIVE FOR MONTREAL HARBOUR.

FIG. 4. FIVE OF THE NINE 100-TON LOCOMOTIVES SUPPLIED FOR MONTREAL HARBOUR.

are mounted underneath the superstructure to ensure a constant supply of air.

On the roof of the locomotive are mounted a jib crane and a collapsible swinging gantry. These are electrically operated, the current being obtained from the 120-volt generator.

The crane is suitable for lifting material up to a weight of 5 tons, at a maximum radius of 12 ft. from the centre line of the locomotive, and to a height of 12 ft. above rail level; it is operated by two " English Electric " totally-enclosed weather-proof motors of 10 h.p. and 5 h.p. for the raising and slewing operations respectively. These motors are operated from controllers in one of the driving cabs.

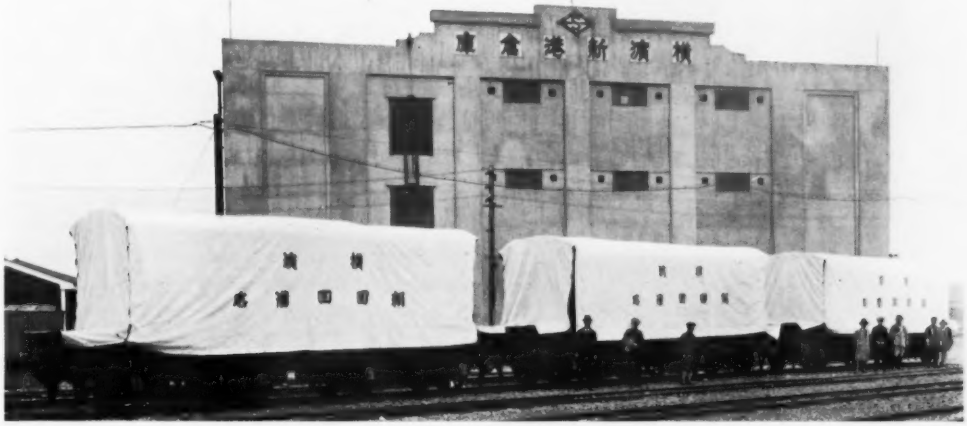
The gantry has an operating radius of 12 ft. from the centre line of the locomotive, and can be raised high enough to enable work to be carried out on the highest portions of the overhead line —23 ft. above rail level. The operation of the gantry is effected by electric motors, the controllers for which are mounted on the gantry itself. By this arrangement the men working on the gantry have complete control of its movement. The gantry is also provided with an emergency valve for actuating the air brakes of the locomotive.

The driving cab at one end of the locomotive is designed to give the driver a view to the rear, as in the case of the main locomotives, and all driving is done from this end.

All motor control apparatus, switchgear and fuses are mounted on a slate panel inside the central portion of the locomotive.

The principal dimensions of the locomotive are as follows :—

Gauge	...	...	4 ft. $8\frac{1}{2}$ in.
Weight	...	...	54 tons
Overall length	...	...	35 ft.
Bogie wheel base	...	...	7 ft.
Bogie centres	...	...	16 ft. 6 in.



Hokuso Railway, Japan.

The three locomotives delivered to the Hokuso Tetsudo K. K. in the spring of this year are representative of a line of standard 0-4-4-0 units which this company has developed for service on D.C. systems of 3 ft. 6 in. gauge, operating at 1,200 or 1,500 volts. As will be seen from the illustrations, which show the locomotives ready to be taken to their destination after arrival in Japan, they are of the box cab design with two driving positions. They have a total weight of 33 tons each, and will be operated from an overhead line at 1,500 volts. D.C., from which current will be collected by a single pantograph of the double-pan type which is raised by compressed air and lowered by springs.

The power equipment consists of four self-ventilated motors, connected in pairs in permanent series, with a one-hour rating of 105 H.P.; the corresponding speed is 18 miles per hour with a gear ratio of 81 to 15.

Control is effected on this company's all-electric camshaft system and is arranged to give nine series and six parallel notches. The operating circuits are served by a 120-volt supply obtained from a 2 kW. motor-generator set driven by a 1,500-volt motor. The braking equipment consists of a Westinghouse AMF air-brake, with a D.H. 25 air compressor driven by a 1,500-volt motor, while hand brakes are also provided, with an operating wheel in each cab.

"English Electric" Power Factor Compensator.

The readers of this Journal will be well aware that The English Electric Company has taken an active part for many years past in developing apparatus of various kinds to meet the modern demand for a better power factor in A.C. motor installations; the Company's designs for this purpose have included motors of special types to operate at high power factors and to contribute to the power factor correction of the installation as a whole, and also independent units for application either to individual motors or to entire systems of any size.

The machines described in the present article are primarily intended for application to new or existing induction motors and are of the type known as A.C. exciters. They may be driven by an independent motor or coupled to the main motor by a direct drive or by belt. Their purpose is to generate an E.M.F. at slip frequency and to impress this on the rotor circuit of the main induction motor so as to correct the power factor of the rotor and consequently of the stator also.

The revolving part of the machine, Fig. 3, consists of an armature and commutator similar to that of a D.C. exciter, but with the difference that the winding span is shorter to suit the three-phase connections. This armature runs in a laminated stator, Fig. 2, having main poles, commutation poles and compensating windings; the number of main poles is three or a multiple of three. Normally, the fields are of the compound-wound type, the ends of the shunt field coils being connected across the brush arms through an adjustable resistance. The armature is supported in roller bearings and the shaft is extended to take a half-coupling or pulley. The speed adopted depends on the particular performance required, and may be from 1,000 to 3,000 r.p.m.

In considering the principle of operation, it may be said that whereas a synchronous motor is excited with direct current an asynchronous motor must be excited with alternating current at slip frequency. If the whole of the magnetising current in the latter case is supplied from a separate source, the motor itself will operate at unity power factor, since it will not draw any magnetising current from the main supply. The purpose of the phase compensator or exciter is to furnish current at slip frequency and of appropriate value and phase for separately exciting the induction motor, and thereby to give control of the power factor.

Apart from the question of frequency and phase, the exciter may be considered as acting just like a self-exciting D.C. machine. An important feature is that the field windings are normally so proportioned that the power factor is practically constant for the whole load range, that is to say, if the power factor is unity at full load, the leading wattless kVA. at no-load will be quite small. The machine is, therefore, self-regulating, and does not require a shunt regulator, although a regulator can be supplied if

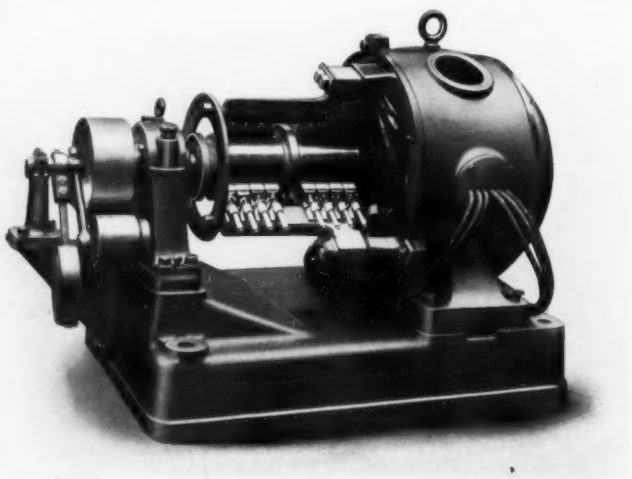


FIG. 1. "ENGLISH ELECTRIC" POWER FACTOR COMPENSATOR.

considered necessary in a particular case.

A compensator to give unity power factor at full load and to supply leading kVA. at no-load will probably meet the majority of cases, and it is of interest to note that the most efficient use of the apparatus is made when the power factor correction is carried to between .95 lagging and .95 leading at full load. Substantial leading power factors at full load can, however, be obtained in most cases if required, but the particular circumstances would call for special investigation.

The special advantages of the power factor compensator may be summarised as follows :—

(1) The power factor of the main motor is practically constant over the working range, and only a slight extra leading component is given at very light loads.

(2) The overload capacity of the main motor is somewhat increased.

(3) The efficiency of the whole equipment will generally be higher than that of an induction motor without a compensator.

(4) In most cases starting is performed in exactly the same way as with an induction motor, but where a change-over switch is provided, as described later on, the additional switchgear is small and simple.

(5) The power factor of the main motor at any particular load may be adjusted by means of the resistance in the field circuit.

(6) The addition of the compensating and commutation pole windings ensures good commutation. It should be particularly noticed that these cannot be applied to the statorless type of power factor compensator, which can only be made in a series design, which gives no improvement to power factor at no-loads above that of a plain induction motor.

FIG. 2. STATOR OF POWER FACTOR COMPENSATOR.

(7) No separate source of direct current is required for excitation purposes ; if, however, it is desired to drive the compensator by an independent motor, any convenient low-voltage A.C. or D.C. supply can be utilised.

(8) The power factor compensator can, if required, give a leading power factor at full load, although the cost of the equipment is thereby increased.

The simplest form of starting gear consists of an open star or straight-through type of liquid starter, the three connections on one side going straight through to the rotor slipring terminals, and the three connections on the other side going to the compensator which forms the neutral point. The operation of starting is then exactly the same as for an induction motor.

If the power factor compensator is driven by an independent motor, it is desirable to arrange an interlock on the starter of the latter in order to make sure that the compensator is running before

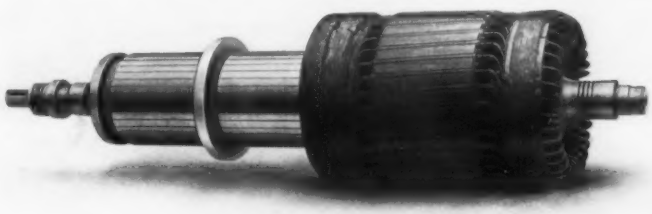


FIG. 3. ARMATURE OF POWER FACTOR COMPENSATOR.

current is switched on to the main motor.

Where the starter is of the closed-star type or is at some distance from the equipment, a change-over switch is supplied with an interlock to ensure that the rotor of the main motor is connected to the starter for running up. The change-over switch is moved over to the running position to place the compensator in circuit.

A comparison between a slow-speed induction motor to operate without a power factor compensator and an induction motor of equal output with a compensator equipment, will often show that the improvement in power factor is obtained without any, or only a slight, extra cost. The relative performances in the two cases is illustrated by the curves in Fig. 4, from which it will be seen that the kVA. at full load is reduced by about 17 per cent. by the addition of the power factor compensator; if the average loading is lower than this, the percentage reduction in kVA. is even greater.

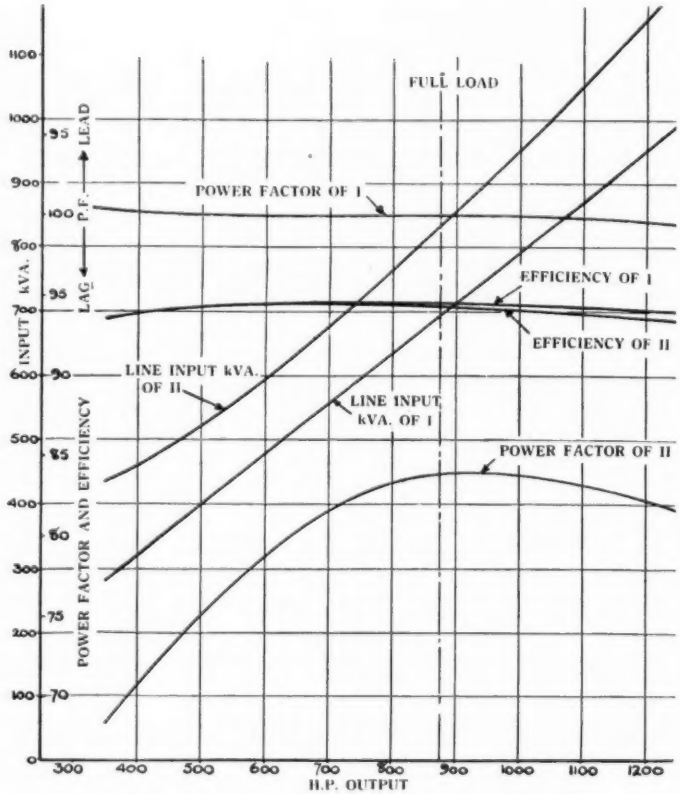


FIG. 4. RELATIVE PERFORMANCE OF 875 H.P., 250 R.P.M. INDUCTION MOTOR. I WITH P.F. COMPENSATOR. II WITHOUT COMPENSATOR. SUPPLY 440 VOLTS, 3-PHASE.

There will be a direct gain by adding the phase compensator if power is bought on a basis of a maximum kVA. demand charge plus a charge per unit consumed, or on any similar tariff. Assume that the motor is of 875 h.p., in order to utilise the curves of Fig. 4, and that it operates throughout the year at an average of three-quarters of full load; further, that there is a maximum demand charge of £4 per kVA. per annum.

It is unlikely that the maximum demand will be less than three-quarters of full load; at that figure a plain induction motor takes 636 kVA., whereas with a phase compensator this is reduced by 116 kVA. to 520 kVA. This saving amounts, in terms of money, to £464 a year on the maximum demand charge alone, and the cost of the compensator will be recouped in six months.

Actually, there will also be a saving in the number of units consumed, since the phase compensator brings about an increase in efficiency at loads beyond three-quarters full load. Improvement of the power factor leads to better voltage regulation, reduction in the cost of mains and transformers, and an increased margin of carrying capacity in existing cables. It may therefore be said that in nearly every case it will be worth while to investigate the use of phase compensators with new motors and their addition to existing induction motors.

Low-Voltage Auxiliary Supply on D.C. Rolling Stock.

The problems presented by the auxiliaries on electric locomotives and motor coaches are often more troublesome than the main equipment. One of these problems is the supply of power at a suitable voltage for operating control gear, lighting, etc. The difficulty arises owing to the large and rapid fluctuations of the main supply voltage met with on a traction system.

On a 600-volt D.C. system the auxiliary services are supplied direct, and the voltage variations are more or less apparent in the brightness of the lights, and, in particularly bad cases, in the operation of the control gear.

At a voltage of 1,500 D.C. it is still possible to supply the auxiliaries direct, but generally for this voltage, and certainly for higher voltages, a motor generator or rotary transformer is run from the main circuit and supplies power at a lower voltage for the auxiliaries.

The type of machine which would naturally be considered first would be a shunt motor coupled to a shunt generator. Such a machine would be quite satisfactory on an industrial supply, but is quite unsuitable for traction work. For the latter, the motor has to be capable of running up to speed when switched directly on to the supply, and it also has to withstand violent voltage jumps and interruptions of supply. This suggests the use of a series winding in the motor and possibly an external resistance as well. Both these provisions introduce speed changes with variation of load, especially if the machine is normally saturated. Thus, for any given load, the speed of the motor will vary with the supply voltage, and, further, there will be a fairly large fall in speed from no load to full load on a fixed voltage.

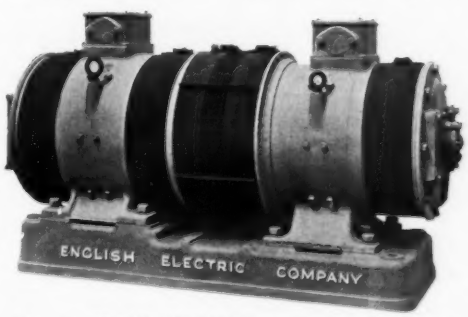


FIG. 1. 5½ KW. 1500/120-VOLT TRACTION MOTOR-GENERATOR.

By using an unsaturated machine it is possible to reduce the variation of speed with supply voltage, but this results in an increase in size and weight of the machine.

With small machines the shunt field of the motor cannot be arranged for excitation from the main supply owing to the difficulty of making a sufficiently robust winding for this voltage. For such sets, therefore, the motor is excited from the low-tension side.

The effect of this speed variation on the low-tension voltage is as follows :—

In the simpler machines the generator has to be shunt excited, so that a drop of speed leads to a reduction in the excitation, and this, in turn, causes a further drop of voltage, the result being that a stable position is only reached when the percentage drop of voltage is about twice the percentage change in speed.

One step in the right direction, therefore, is obviously to endeavour to keep the shunt excitation of the generator constant. This can be done very effectively by the use of stabilising resistances in the form of iron wire in an atmosphere of hydrogen. With this arrangement the low-tension voltage can be made directly proportional to the speed, and the addition of a compound winding can compensate for the changes in load. The nett result is a set where the low-tension voltage varies almost directly in proportion to the applied voltage under all normal conditions. This is an improvement on the simple set, but it is at the expense of additional field copper in the generator and special stabilising resistances, and the final improvement obtained is, perhaps, not sufficiently great to justify the additional complication and expenditure. The arrangement is, however, in satisfactory operation on some electrification schemes.

Other schemes have been developed dependent for their operation on the use of a separate exciter,

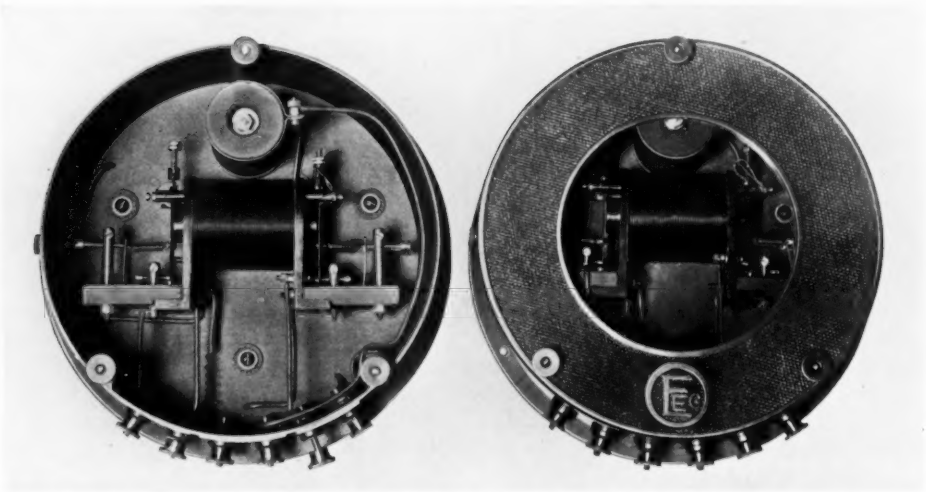


FIG. 2. AUTOMATIC VOLTAGE REGULATOR FOR MOTOR-GENERATOR ON 1500-VOLT SYSTEM.

and there are various methods of application which lead to satisfactory results. Broadly speaking, the method depends on the use of two field systems, one of which has a fair degree of saturation, the other being almost unsaturated. If the exciter is shunt wound and unsaturated, its percentage change of voltage will be more than twice the percentage change of speed, and if this voltage is used to excite the motor, the result is that there is only a small change of speed for a considerable change in line voltage. Having obtained a fairly constant speed, an ordinary compounded generator gives the required result. The chief objection to this scheme is that to obtain regulation over a wide range of supply voltage necessitates the use of a large exciter with a consequent increase in weight and price of the machine. The size of the motor is also increased.

A number of machines have been designed on the "3-brush" principle with varying success. Some of them rely on field distortion to provide a de-compounding effect with the aid of a third brush. As this third brush must operate on an active part of the commutator, it is only possible to make a satisfactory machine when the voltage per bar is very low. Generally speaking, the voltage of such machines on the low-tension side is limited to something in the neighbourhood of 30 volts. Moreover, it is believed that all machines working on this principle depend on the use of a battery in parallel with them, to enable constant voltage to be obtained. If the battery becomes disconnected, a serious rise of voltage may be obtained.

For higher voltages, machines of this type consist essentially of an arrangement corresponding to a 2-pole armature in a 4-pole field. This is really a variation of the exciter scheme mentioned above, as it depends on the interaction of saturated and unsaturated magnetic fields. The saturated field gives a voltage which is proportional to the speed, and the unsaturated field gives another voltage which changes at a greater rate than the speed. These voltages are induced in one armature winding, and are opposed to one another between the main brushes. An intermediate brush collects current at a varying voltage for excitation of the unsaturated field system; for example, on a 120-volt machine at a certain speed, the main field might produce 200 volts, and the cross field, minus 80 volts, leaving 120 volts on the main brushes. A rise of speed of 20 per cent. would change these figures to 240 and 120, still giving 120 across the main brushes.

The English Electric Company have built successful machines of this type, but have come to the conclusion that there are several

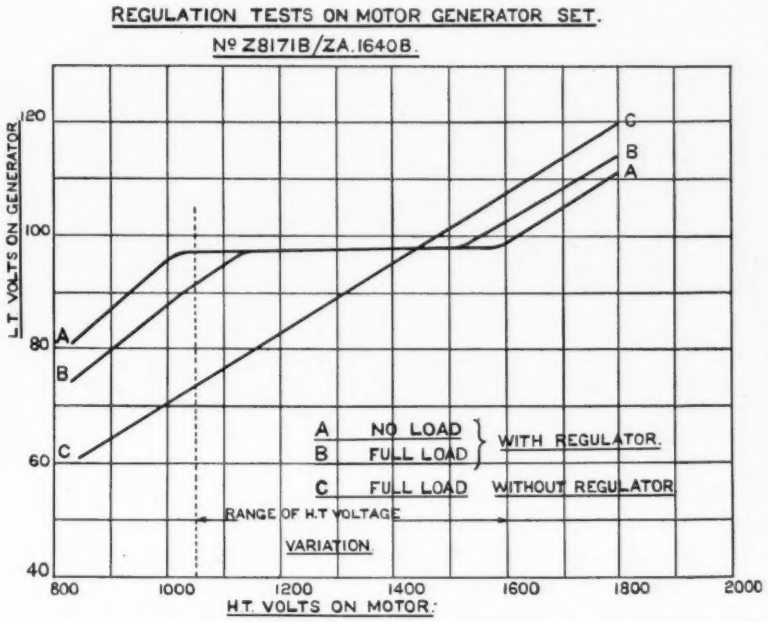


FIG. 3. VARIATION OF L.T. VOLTAGE WITH SUPPLY PRESSURE.

disadvantages which make the machine fall short of what is required for traction purposes. The set is very large for its output, and voltages are present on the commutator very much in excess of the allowable L.T. voltage, and there is a danger of this high voltage getting through to the low-tension side. It may amount to as much as 400 volts on a 120-volt circuit. The machine is sensitive to changes of temperature in the field windings, the position of the brushes, and the condition of the intermediate brush.

After careful consideration of the above points and others bearing on the question, the Company's designers have come to the conclusion that a machine built on conventional lines and the use of a separate automatic regulator has fewer objections than the other schemes.

Looking at the problem generally, it is obvious that to obtain a constant low-tension voltage, at least one feature in the system must be constant. For example, an ordinary shunt motor depends on a constant applied voltage to give a constant speed, and an A.C. motor relies on a constant frequency. In the case of a traction motor-generator, however, there is no fixed factor which can be used as a basis of operation. Artificial constants such as balance between two field systems of varying saturation, are liable to change with temperature and other causes, and it therefore appears that a more satisfactory basis is some physical quantity which can be relied on to remain constant, as, for example, the pull of a spring. Such a basis is used in the regulator scheme which has been applied successfully in various cases.

A regulator has been developed for the English Electric Company by Messrs. Cox-Walker & Co., and consists of a small vibrating contact which cuts in or out a small resistance in the generator field. The range is sufficient to give full voltage with the resistance all out at the lowest running speed, intermediate steps being dependent on the frequency of vibration of the contact.

To meet a still wider range, the regulator can be arranged to operate both on the generator and the motor fields. Thus a very close regulation indeed can be obtained.

As an example of the operation of the system, we may refer briefly to the Motor-Generator Sets fitted on some 1,500-volt Motor Coaches supplied recently to the La Guaira & Caracas Railway. The regulator, which is shown in Figure 2, is only about 6 in. in diameter. Its effect in controlling the L.T. voltage is illustrated in Figure 3. The range of constant low-tension voltage could be extended, if necessary.

THE PRODUCTS OF The English Electric Company

GENERATING PLANT for STEAM, WATER or OIL POWER

Complete Power Stations of any size. Steam Turbines & Turbo-alternators. Surface Condensers. Horizontal & Vertical Water Turbines & Alternators. Diesel & Fullagar Oil Engines. Alternators & D.C. Generators for all forms of drive.

ELECTRIC TRACTION

Complete Electric Traction Systems. Electric Locomotives. Electric Motor-coach stock. Diesel-electric stock. Motors & Control Equipment for Railway or Road Vehicles. Battery Locomotives. Industrial Locomotives for all services. Electric Tramcars. Electric Trolley Buses. Tramcar & Bus Bodies.

TRANSMISSION SYSTEMS at ANY VOLTAGE

Complete Indoor or Outdoor Switching Stations. Oil Circuit-Breakers of large rupturing capacity. Isolating Switches of all types. Transformers of any size, type or voltage. Booster Transformers. Induction Regulators. Instrument Transformers.

SUB-STATIONS & CONVERTING PLANT of ALL KINDS

E.H.T. & L.T. Switchgear. Complete Automatic Switching Equipments. Kiosk-type substations. Rotary Convertors. Motor Convertors. Motor-generators. Frequency Changers.

POWER EQUIPMENT for ALL INDUSTRIES

Specialists in the complete electrification of:— Iron and Steel Works. Non-ferrous Metal Works. Collieries. Quarries & Mines of every description. Brickyards. Cement Works. Sewage & Irrigation Works. Dockyards. Engineering Shops. Chemical Factories Dyeworks. Glass Works. Rubber Mills. Cotton, Wool, Silk & Jute Mills. Pulp & Paper Mills. Breweries. Sugar Factories. Food Factories.

A.C. & D.C. Motors & Control Gear in units from ¼ H.P. to 20 000 H.P. to meet all modern conditions of Starting Torque, Power Factor Correction, etc.

WORKS:
BRADFORD, COVENTRY, PRESTON, RUGBY, STAFFORD
HEAD OFFICE: QUEEN'S HOUSE, KINGSWAY, LONDON, W.C.2

A NEW CONCEPTION OF INDUSTRIAL INSTRUMENTS.

ELECTROFLO MULTIPLE METERING SYSTEMS

THE original Electroflo meter was very considerably more useful than any of its contemporaries, because there was no restriction upon the location of its reading instruments. The indicators, recorders and integrators of any number of meters could be centralised, grouped or de-centralised to meet any operating requirement. Far greater use was consequently made of the flow meter readings and immediate action could be taken if any unsatisfactory tendency became apparent. Much time and money were saved.

This year Electroflo takes another forward step, and achieves the long-desired centralisation and CO-ORDINATION of ALL the records which determine efficiency, and of the indications which guide satisfactory performance. Electroflo efficiency meters and multiple metering systems record on 12" wide charts, lasting 1,200 hours, flows, temperatures, pressures, CO_2 percentages and vacua in any required combination. All of these measurements are accomplished electrically, at any location.

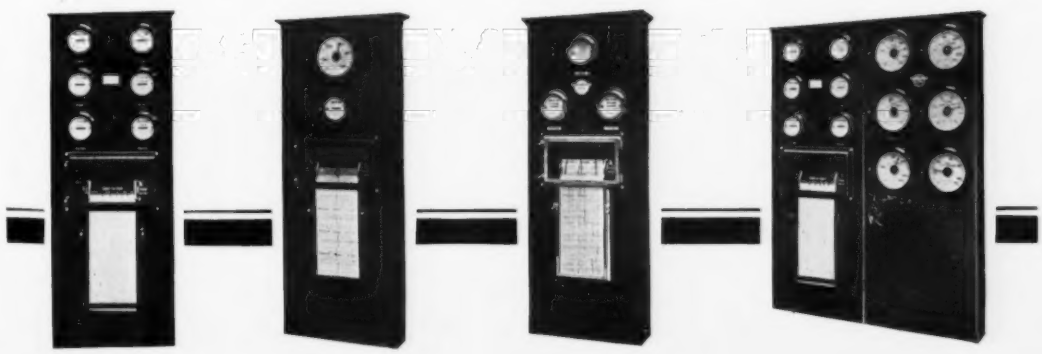
Gone for ever is the necessity of collecting and endeavouring to relate a number of daily charts of different sizes. It is important to note that the methods employed are by no means new and untried, for all the operating movements are those which have been used with such success in individual Electroflo instruments for many years. The system is new in arrangement only.

Attention is drawn to the illustrations of typical Electroflo multiple metering panels already supplied to many British and foreign customers.

Catalogues No. 5028 *and E.M.* 27 *giving complete information will be forwarded gladly upon request.*

ELECTROFLO METERS CO. LTD.

Abbey Road, Park Royal, London, N.W.10.



THE PIONEER

Norman Wilson
FIFTY YEARS AGO TURNER BROTHERS ASBESTOS COMPANY CONSISTED OF FIVE MEN: TO-DAY THE TURNER AND NEWALL GROUP COMPRISES EIGHT WORKS—COVERING ONE HUNDRED & FIFTY ACRES—SEVEN ASBESTOS MINES, INCLUDING THE LARGEST PRODUCING UNIT IN THE UNION OF SOUTH AFRICA, & OVER 5,000 EMPLOYEES.

"There's no sense in going further—it's the edge of cultivation."
Kipling.

IN an Industry, if it is to survive, there must always be those that give brains and capital freely in the attempt to win better and still better value for the users of their products and whose trail of progress is blazed by rejected ideas and scrapped equipment.

EBONY "SINDANYO" represents seven continuous years of scientific investigation in the laboratory, the workshop and in service; it is no accident, as are the materials it is rapidly superseding, but is to day *exactly what we intended it to be* when first we set out to produce it, ten years ago.

There is no valid reason why any manufacturer of Switch and Control Gear should continue to mount apparatus on the *unscientific* materials that were only just good enough at the birth of the Electrical Industry and which, under to-day's conditions, are fundamentally unsound, when the use of Ebony "Sindanyo" *not only raises the standard of quality of the complete product,* but actually materially reduces the total cost of production of the unit.

Please write for BROCHURE *No. 16.*

Switchboard with Ebony "Sindanyo" Panels. *Reproduced by courtesy of The English Electric Co., Ltd.*

C.F.H.6

"SindanyO"

REGISTERED

INSULATING · BOARD.

·DIELECTRIC·HOMOGENEOUS·STRONG·

TURNER BROTHERS ASBESTOS COMPANY LTD., ROCHDALE, ENGLAND

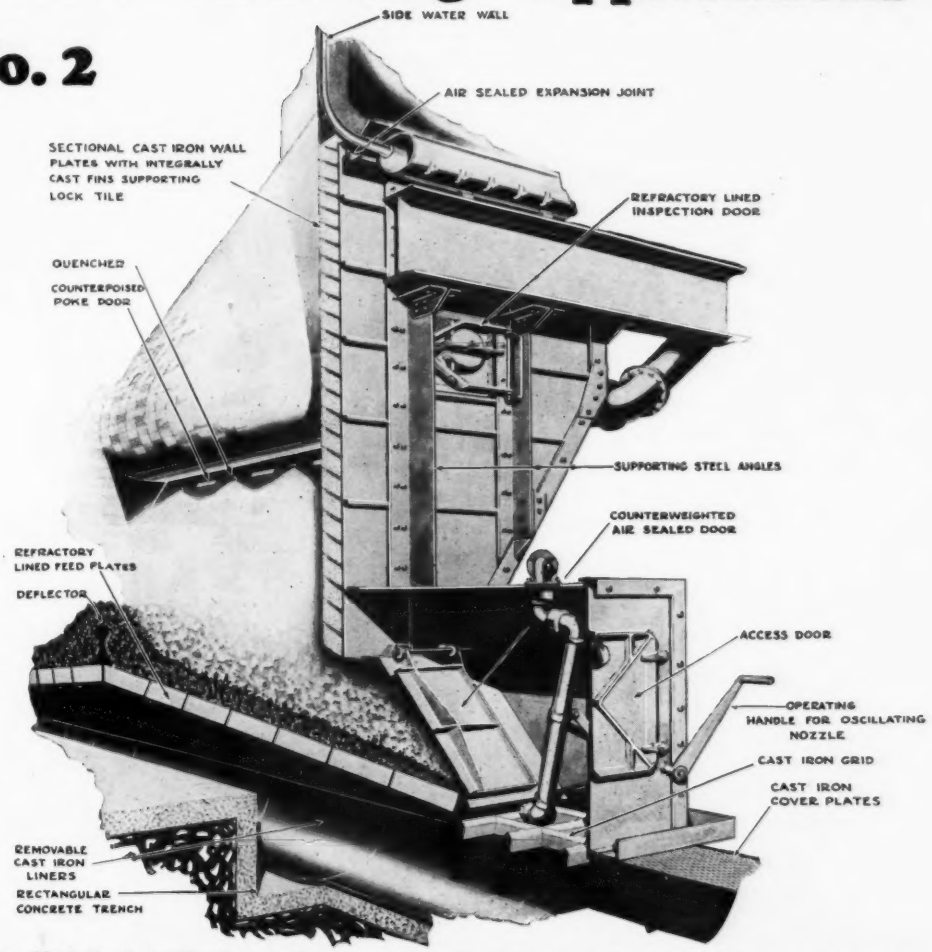
Manufacturers of
EVERYTHING IN ASBESTOS
for the
Electrical, Electro-Chemical and Mechanical Engineering Industries

Specify
ASH
Products

HYDRO JET
TRADE MARK

Ash Handling Applications

No. 2



One Method of Application to Pulverised Fuel Fired Furnaces fitted with Water Cooled Walls.

The ash is stored for 8 to 24 hours. Quenchers prevent the formation, in the storage hopper, of large clinker. When the hopper is full the ash is handled to the final point of disposal by one man working for 10 to 15 minutes per boiler. The system is constructed throughout on the principle of having nothing but corrosion-resisting cast iron in contact with the ash water.

THE ASH COMPANY (London) LIMITED
63, Lincoln's Inn Fields, London, W.C. 2

Specify
ASH
Products

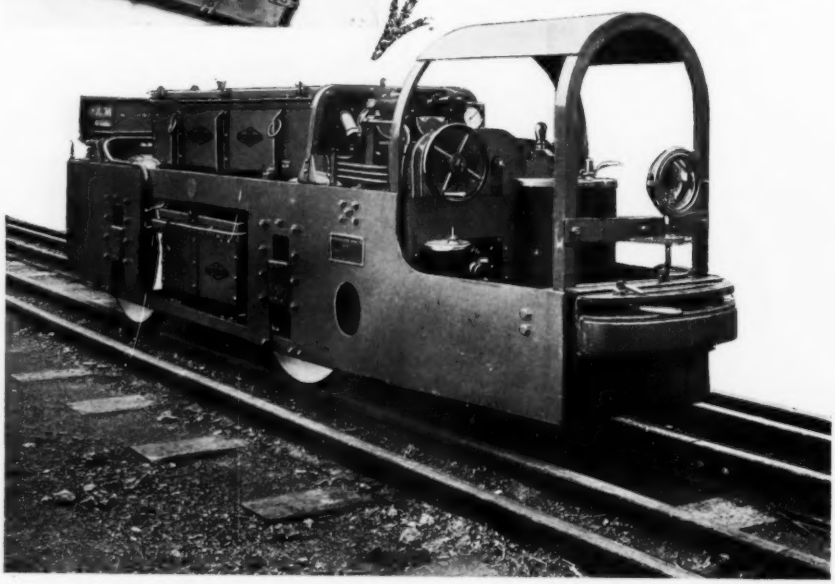
LOCOMOTIVE FOR THE POST OFFICE TUBE RAILWAY

—another example of English Electric engineering plus

D.P. KATHANODE BATTERIES

Booklet Free.

THE D.P. BATTERY CO., LTD.,
Bakewell - Derbyshire.
London: 11, Victoria St., S.W. 1.



S.D. 142

MARELLI
ELECTRIC FANS

A.C. SINGLE-PHASE CEILING FANS

Maestrale - Maestralino - Maestralino Junr. - Condor - Airone.

A.C. THREE-PHASE CEILING FANS

Aliseo - Aliseino

OUR LATEST MODELS EMBODY ALL THE IMPROVEMENTS MADE AS A RESULT OF AN EXTENSIVE EXPERIENCE IN THE TROPICAL MARKET.

MARELLI & CO., LTD.,

FAN HOUSE, GARLICK HILL,

LONDON, E.C. 4.

THE WHITEHEAD LETTER FILE COMPANY

Inventors and Patentees of numerous Devices for the Filing of Letters, Records and the like.

Manufacturers of Filing Supplies—but not of Filing Cabinets—for most Letter Filing Systems.

The neatest and tidiest Vertical Filing System is ours : the Files cannot ride-up in the Drawers. Ask for a sample Double-Cut File.

Makers of Covers for Sectional Catalogues, for Estimates, for Works Stores Supplies and for Working Drawings.

Any kind of cover from the delicate artistic to the tough and untearable.

Proprietors of that very excellent Paper fastener—The Owl Clip.

"An eye for Business? One too few!
Observe this Clip : This Clip has two."

Sole Consignees of the Swedish production—The Agrippa File.

The Best Letter File made on the Continent of Europe.

And, whenever there is Quantity, Quotations will be given for Loose Leaf Sheets and Indexes of most kinds.

Hotspur Works, Powell Street, London, E.C.1.

OMNIBUS BODIES

Built by the Traction Works of The English Electric Company, the Bus illustrated is eminently suitable for duties imposed by modern transport conditions.

ROBUST AND SOUND CONSTRUCTION. MINIMUM WEIGHT. LONG LIFE.

LET US QUOTE FOR YOUR REQUIREMENTS.

Six Wheeler Single-Deck Motor Omnibus for one man operation, supplied to Ashton-under-Lyne.

The ENGLISH ELECTRIC Company Limited.

WORKS:- BRADFORD, COVENTRY, PRESTON, RUGBY, STAFFORD.
HEAD OFFICE:-
Queen's House, Kingsway, London, W.C.2.

Mica, Leatheroid, Vulcanized Fibre

EMPIRE CLOTH AND TAPE

Bakelite Sheets, Tubes, Spools, etc.

for Oil-immersed Apparatus and Transformers.

BAKELITE RESIN, VARNISH & MOULDING POWDER.

PRESSPAHN, FULLERBOARD, EBONITE and all Insulating Material for Electrical Manufactures

ATTWATER & SONS,

Established 1868.

PRESTON, ENGLAND.

Contractors to the British, American, French and Italian War Offices and Admiralties.

AS IN BLOCKMAKING - SO IN PHOTOGRAPHY.

QUALITY HAS ALWAYS BEEN OUR FIRST OBJECTIVE.

WE SEND OUR OWN PHOTOGRAPHERS TO ALL PARTS OF THE UNITED KINGDOM AND THE CONTINENT.

A L F R E D

CRASKE

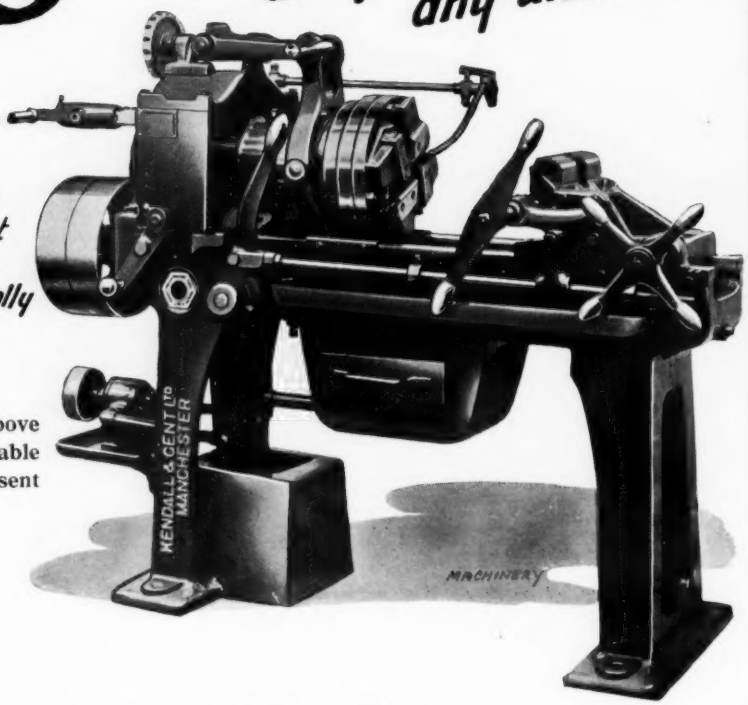
MAKERS OF BETTER BLOCKS

5, EAST HARDING STREET, E.C.4.

Telephone: CENTRAL, 2602, 2603 & 2646

K&G SCREWING MACHINES

for ¼" to 4" Whitworth Bolts and for Tubes up to any diameter.



MAIN FEATURES:

Tangential Dies which can be adjusted whilst machine is running.

Dies held in exceptionally rigid manner.

Full catalogues of the above machines and our new portable Radial Drilling Machines sent on application.

When better Machine Tools

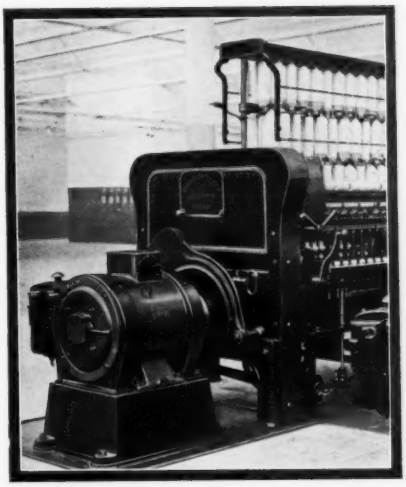
can be built, A.B.M.T.M.

will be the Builders.

ASSOCIATED BRITISH MACHINE TOOL MAKERS L.TD

17, GROSVENOR GARDENS. LONDON, S.W.1.

MOTORS *for* TEXTILE DRIVES



9 BHP. High-torque, Pipe-ventilated, Squirrel-cage Motor driving Twist Ring Spinning Frame.

This is one of 105 exactly similar machines for The Dunlop Rubber Company for extension of their Cotton Mill near Rochdale. Nearly 400 motors, for individual drives, have been supplied for this extension——

aggregating 1,600 BHP.

The ENGLISH ELECTRIC Company Limited.

WORKS:- BRADFORD, COVENTRY, PRESTON, RUGBY, STAFFORD.
HEAD OFFICE:-

Queen's House, Kingsway, London, W.C.2.

INDEX TO ADVERTISERS

Alfa-Laval Co., Ltd. V
Ash Company (London) Ltd. XIII
Associated British Machine Tool Makers, Ltd. XVIII
Attwater & Sons XVII
Broadbent, Thos. & Sons, Ltd. IX
Craske, Alfred, Ltd.... XVII
Davy Brothers Ltd. V
D. P. Battery Co., Ltd. XIV
Electroflo Meters Co., Ltd..... XI
English Electric Company Limited II, XVI, XIX
Equipment & Engineering Co. Ltd. VII
Heenan & Froude Ltd. IV
London Electric Wire Co. & Smiths Ltd. VIII
Marelli & Co., Ltd. XV
Mason, E. N., & Sons, Ltd..... VI
Mitchell Conveyor Co. Ltd. III
Renold, Hans, Ltd. IV
Siemens Brothers & Co. Ltd. X
Straker Brothers, Ltd. XX
Strathclyde Paint Co., Ltd. VIII
Taylor, Tunnicliff & Co., Ltd. VII
Turner Brothers Asbestos Co. Ltd. XII
Whitehead Letter File Co. XVI
Yorkshire Copper Works, Ltd. I

All communications respecting Editorial Contents and Advertising Rates should be addressed to The Editor, The English Electric Journal, Queen's House, Kingsway, W.C.2.

When communicating with Advertisers please mention English Electric Journal.

THE BISHOPSGATE PRESS

(Straker Brothers Limited)

Established 1800.

PRINTERS & ACCOUNT BOOK MANUFACTURERS.

We welcome Enquiries for Every Class of Work.

WEST FRONT OF NEW STREET PREMISES, SHOWING CONNECTING BRIDGE.

THE FRONT ENTRANCE

IN THE ORDER OFFICE

Telegrams : Straker, London.

Telephone : Bishopsgate 2444 (4 lines).

194-200, Bishopsgate, London, E.C.2

"Yorkshire"

"The Specialised Tube."

Condenser Tubes
in Brass
Admiralty Brass
Aluminium-Bronze
Cupro-Nickel
(80/20, 70/30, 60/40, etc.)
and other alloys

Deliveries from
Stock

YORKSHIRE
Nothing but Tubes
COPPER WORKS LTD

LEEDS, ENGLAND.
Telephones: 20031. *Telegrams:* "*Tubes, Leeds.*"
LONDON OFFICE: 53, New Broad Street, E.C.2

Install Renold Stock Drives and gain these advantages

Immediate delivery. Any drive up to 100 H.P. despatched from Stock.

No waiting for quotations. The Renold Stock Drive Booklet gives full specifications and prices for complete drives, and makes drive selection simple.

Low cost. Prices of Renold Stock Drives compare very favourably with those of other forms of power transmission. Maintenance costs are negligible.

Power saving. Renold Stock Drives transmit full power smoothly and without slip or friction.

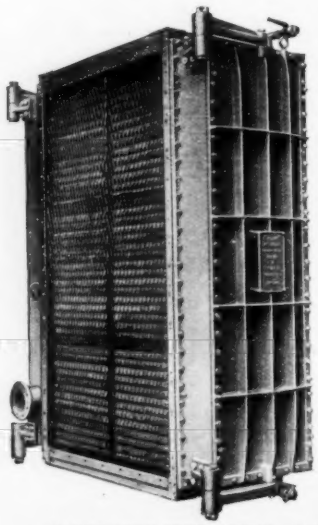
RENOLD
STOCK DRIVES

1 to 100 H.P. STOCK DELIVERY

HANS RENOLD LIMITED, DIDSBURY, MANCHESTER

Heenan

PATENT ENCLOSED CIRCUIT AIR COOLERS



for the ventilation of Turbo-Alternators are GUARANTEED to provide a continuous supply of cool, clean, dry air which can be relied on in any climate. Moreover, by means of this simple system, running expenses and risk by fire are reduced to a minimum.

The following is a Small Selection of Names of Purchasers :—

Aberdeen Corporation
British Admiralty
Barnsley Corporation
Bradford Corporation
Bedford Elec. Dept.
Brush Electrical Eng. Co. Ltd.
British Brown-Boveri Ltd.
British Thomson-Houston Co. Ltd.
Consett Iron & Steel Co. Ltd.
English Electric Co. Ltd.
Edinburgh Corporation
Formby Depot (L.M.S. Rly.)
General Electric Co. Ltd.
Glasgow Corporation
James Howden & Co. Ltd.
Hull Corporation
London Power Co. (Bow Road Stn.)
London Power Co. (Deptford Stn.)
Leicester Corporation
Lancs. Dynamo & Motor Co. Ltd.
Marylebone Corporation
Metropolitan-Vickers Electrical Co., Ltd.
Newport (Mon.) Corp.
Ocker Hill Generating Stn.
Oerlikon Ltd.
Peterboro' Corporation
Preston Corporation
Powell Duffryn S.C. Co. Ltd.
S. Wales Power Co. Ltd.
Stepney, Met. Borough
Stockport Corporation
St. Pancras Boro' Council
Woolwich Corporation
Worcester Corporation
Yorks Elec. Power Co.
Auckland Power Stn. N.Z.
Adelaide Tramways
Athens, St. George's Power Stn.
Centrale de Droogen-bosch (Brussels)
Capetown Suburban Rly.
Eastern Bengal Rlys.
Perak Power Station
State Coal Mines (Holland)
Etc., Etc.

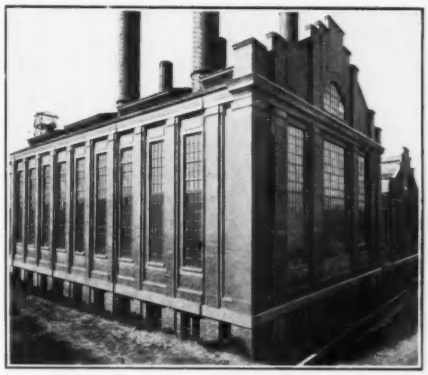
Please send for descriptive Literature.

HEENAN & FROUDE, LTD.,
WORCESTER . ENG.

ILLUSTRATION SHOWS TYPICAL "HEENAN" ENCLOSED CIRCUIT AIR COOLING UNIT (Note Hinged Doors to facilitate cleansing of Tubes).

STOURPORT.

TYPES OF MITCHELL POWER STATION BUILDINGS



PRESTON.

BROADLY speaking the types of Stations erected in this country can be divided into four, as follows :— The "public building" type of station as built at Stourport for the Shropshire, Worcester and Staffordshire Electric Power Company. This station is constructed of artificial stone and brick on bold and imposing lines.

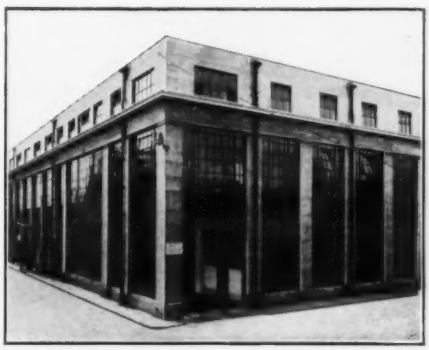
The second type, such as Preston Power Station, which is a steel frame building with thin brick panelling. The third type is the Power Station built for the Poplar Borough Council. This, as in the second type, is a steel frame building filled in with thin panelling. All these buildings have the main load carried by a steel frame structure, and for this reason are rapidly erected.

The fourth type of station was erected for the Peterborough Corporation. This is constructed throughout of Ferro-concrete, and, as may be seen from the illustration, has an appearance entirely different from the usual run. This type of design has been evolved to secure low cost ferro-concrete construction.

We have complete Architectural, Civil and Ferro-Concrete Designing and Erecting Staffs, competent to tackle any size undertaking and to carry it out quickly, efficiently and at rock-bottom price.

POPLAR.

Apply to the BUILDING DEPARTMENT OF



PETERBOROUGH.

THE MITCHELL CONVEYOR COMPANY LIMITED,

ATLANTIC HOUSE,

45-50, HOLBORN VIADUCT, LONDON, E.C.1.

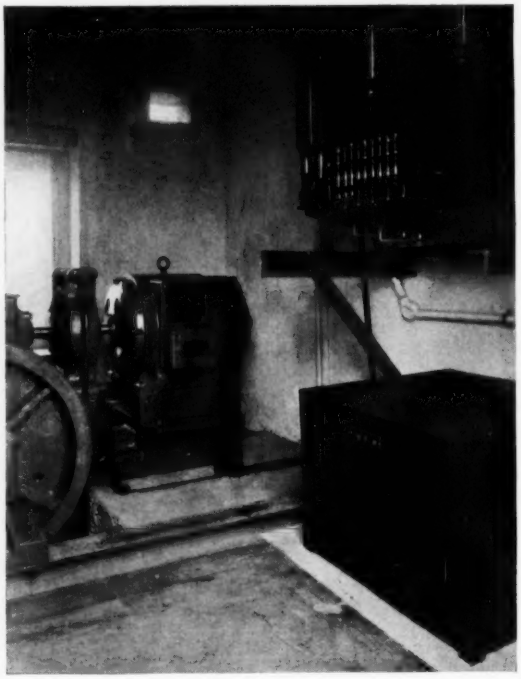
DIRECT CURRENT

FOR ANY PURPOSE
CAN BE OBTAINED
READILY

FROM AN
A.C. SUPPLY

BY USING

THE



WESTINGHOUSE

METAL RECTIFIER.

The illustration above shows a typical equipment for working a 14-passenger lift at a speed of 200 ft. per min. The motor is a 3-phase machine controlled by a standard control panel, direct current for which is supplied by a Westinghouse Metal Rectifier which also serves the brake solenoids.

Reproduced by courtesy of Penrose Lifts Ltd., of 239/244, Southwark Bridge Road, London, S.E.1.

WESTINGHOUSE METAL RECTIFIERS DO NOT EMPLOY VALVES OR MOVING PARTS, NOR IS THEIR LIFE LIMITED BY CHEMICAL ACTION SUCH AS OCCURS IN WET OR DRY ELECTROLYTIC RECTIFIERS.

Send for descriptive pamphlet D.P.16h to

The Westinghouse Brake & Saxby Signal Co., Ltd., 82, York Road, King's Cross, London, N.1.

DE LAVAL CONSERVATOR Transformer Oil Purifiers.

A De Laval Conservator Transformer Oil Purifier in operation.

For Conservator and other types of Transformers which are designed to prevent the oil from coming into contact with air, it is necessary for the purification to be effected without exposing the oil to air.

It is, therefore, most essential that the Suppliers of the high-voltage Transformers for the National Electrification Scheme should not utilise the ordinary open type of Centrifuge, but the special De Laval Conservator Equipment—the only plant by means of which high dielectric strength can be obtained independent of atmospheric conditions.

This outstanding advantage of the Conservator Type De Laval has been recognised by all well-known Electrical Companies; orders at present in hand including:—

English Electric Co. Ltd.,
General Electric Co. Ltd.,
British Thomson-Houston Co. Ltd.,
Ferranti Ltd.

ALFA-LAVAL COMPANY LTD.,
34, Grosvenor Road, LONDON, S.W. 1.

"DAVY" ROLLING MILL PLANT, STEELWORKS & HYDRAULIC MACHINERY.

We have unique experience in such machinery, having built nearly all the modern plants installed in Great Britain in recent years, as well as many for abroad.

ROLLING MILLS
BLOOMING MILLS. REVERSING PLATE MILLS. THREE-HIGH PLATE MILLS. SECTION MILLS. MERCHANT MILLS. SHEET MILLS. "MORGAN" CONTINUOUS ROLLING MILL PLANTS. TYRE AND WHEEL MILLS. COLD ROLLING MILLS.

ACCESSORY MACHINERY
SHEARS. HOT SAWS. MANIPULATORS. ROLLER GEAR. INGOT TILTERS. ROLL LATHES, ETC.

HYDRAULIC MACHINERY
"DAVY" PATENT HIGH-SPEED FORGING PRESSES. HYDRAULIC PRESSES FOR FLANGING, EXTRUSION, CABLE COVERING, LEAD PIPES, ETC. HYDRAULIC PUMPS AND ACCUMULATORS. INTENSIFIERS. IMPROVED WORKING VALVES.

STEAM HAMMERS OF ALL TYPES.

STEAM BOILERS OF THE LANCASHIRE, CORNISH AND VERTICAL TYPES.

18" and 10" Electrically-driven Merchant Mills

DAVY BROTHERS LTD.

Established 1830 **SHEFFIELD, England.**

E. N. MASON & SONS LIMITED

THE MANUFACTURING DRAWING OFFICE STATIONERS

IMPORTANT ANNOUNCEMENT

TO ENGINEERS

AT HOME AND ABROAD

THE NEW

INDEPENDENT ALL-GEARED

MODEL

OF THE

ARCLIGHT HORIZONTAL PHOTO COPIER

WILL MAKE ITS DEBUT

AT THE

SHIPPING, ENGINEERING & MACHINERY EXHIBITION,

SEPTEMBER 12th to 28th, 1929.

OLYMPIA, LONDON, W.14

IF YOU ARE UNABLE TO VISIT OUR STAND

No. 4, SECTION ZZ (GALLERY),

PLEASE ASK US TO SEND YOU PARTICULARS OF THIS NEW MODEL WHICH EMBODIES THE VERY LATEST AND BEST IN DESIGN, WORKMANSHIP AND PERFORMANCE, INCORPORATING SOME UNIQUE FEATURES OF VITAL INTEREST.

ARCLIGHT WORKS, COLCHESTER, ENGLAND.

LONDON — BIRMINGHAM — MANCHESTER — NEWCASTLE-ON-TYNE.

SIMPLEX

✷ CABLE DRUM JACKS

ESPECIALLY DESIGNED FOR THE SAFE AND EFFICIENT HANDLING OF CABLE DRUMS, WIRE ROPE OR BELTING REELS :: :: :: RUGGEDLY CONSTRUCTED TO WITHSTAND THE HARD WEAR AND TEAR OF ROUGH USAGE ON OUTDOOR SERVICE :: :: ::

Simplex Jacks are built without a single machine screw—expanded rivets only being used, and there are less working parts in a Simplex than in any other similar type of Jack.

✷ ***There's a "Simplex" for every purpose.***

Write to-day for full particulars.

Telephone: Temple Bar 1088 (2 lines).

EQUIPMENT & ENGINEERING CO. LTD

2 & 3, NORFOLK STREET, STRAND, W.C.2.

Telegrams: "Kharparts, Estrand London."

PORCELAIN INSULATORS

EXTRA HIGH TENSION AND LOW TENSION

for

OVERHEAD POWER TRANSMISSION, TELEGRAPH AND TELEPHONE LINES, BUSHINGS, ACCESSORIES, &c., IN HIGHEST GRADE ELECTRICAL PORCELAIN.

"FISH-SPINE" INSULATING BEADS

for Bare-wire Insulation

TAYLOR, TUNNICLIFF & CO., LTD.

Head Office: EASTWOOD, HANLEY, STAFFS.

Telephone: Hanley 5272. Telegrams: Eastwood, Hanley.

Works: HANLEY, STONE & LONGTON.

London Office: 110, CANNON STREET, E.C.4.

Telephone: Manston House 7211.

STRATHCLYDE PAINT CO. LTD.,

Manufacturers of

LEADS, PAINTS, COLOURS & VARNISHES

Specialists in Paints for

MACHINE TOOLS and all kinds of MACHINERY

"Puralb" White Lead Substitute.	"Strathclyde" Enamel Filling up & Dull Steel Grey Paints.	"Strathclyde" Anti-corrosive Oxide Paints.

Contractors to Home & Colonial Governments, leading Railway Co.'s, Car. & Wagon Builders, Engineers, &c.

STRATHCLYDE WORKS, DALMARNOCK, GLASGOW.

Magnet wire unaffected by temperature up to 150°c

No thicker than cotton-covered wire yet insulated with pure Asbestos Fibre!

Lewbestos insulated wire is unequalled—

for use in the manufacture and repair of coils for traction, mining and mill motors; lifting magnets and all apparatus subject to severe temperature rise.

Withstands a test pressure of 1,000 Volts between turns after long period working up to 150° C. (302° F.).

LEWBESTOS is a pure Asbestos Fibre Insulation specially treated to remove all impurities, and it is moisture-proof and tough, but in spite of its toughness it will not crack or break on sharp bends.

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LTD. LEW REGISTERED

LEWBESTOS

REGD.

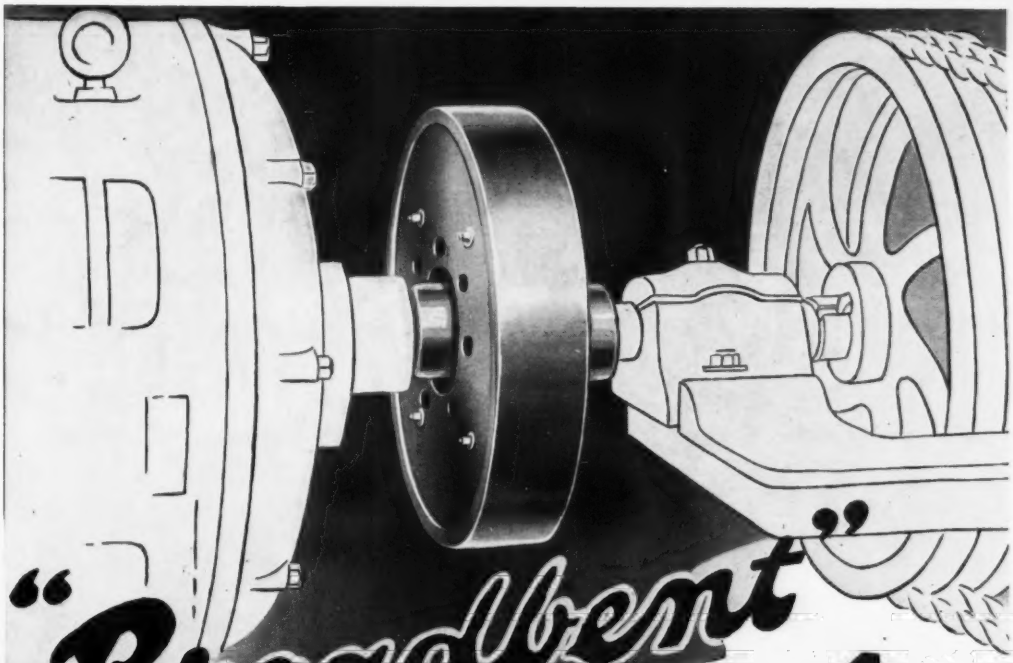
PURE ASBESTOS FIBRE INSULATION

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED

Church Road, Leyton, London, E.10.

Telephone:—Walthamstow 2531. *Telegrams*:—Lewcos, Phone, London.

Trade Counter and Cable Sales: 7, Playhouse Yd., Golden Lane, London, E.C.1.



"Broadbent" Centrifugal Clutches

Illustration shews a Centrifugal Clutch Coupling, also adaptable for Belt, Chain, Gear or Rope Drives.

Write for New Catalogue (7th Edition).

ADVANTAGES:

Ensure Easy Starting of Motor against Full Load.
Reduce Initial Cost of Motor and Switchgear.
Reduce the Starting Current Consumption.
Fast and Loose Pulleys Entirely Dispensed with.
Reduce Wear and Tear of Motor and Driven Machine.
Safeguard the Motor from Breakdown due to Overload.

Over 12,000 already supplied to many of the Largest Firms throughout the World.

Thomas Broadbent & Sons, Ltd., Huddersfield

Pioneers and Original Makers of Centrifugal Clutches.

SIEMENS "NEOPHONE"

THE NEW TELEPHONE

BRITISH POST OFFICE APPROVED PATTERN
with separate bell set.

The NEOPHONE reaches a high standard of TRANSMISSION EFFICIENCY and ARTICULATION never attained before, and positively eliminates Howling, Frying, and Excessive Side Tone, maintaining its efficiency irrespective of the position in which the Microtelephone is held.

Particulars from the Sole Manufacturers:—

SIEMENS BROTHERS & CO., LTD.
WOOLWICH, LONDON, S.E. 18.

Telephone: Woolwich 1161, Extension 238.

Existing standard bell set can be used.